ORIGINAL ARTICLE

Prevalence of anaemia among different physiological groups in the rural areas of Maharashtra

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Abstract

Introduction: Anaemia continues to be a major public health nutritional problem in India, and has adverse health and economic implications. **Objective:** The objective of the study was to assess the prevalence of anaemia among different physiological groups in the state of Maharashtra. **Methodology:** A community based cross-sectional study adopting multistage stratified random sampling procedure was carried out in rural Maharashtra. Information of socio-demographic particulars was collected with pretested questionnaire. A finger prick blood sample of 20 µL was collected from the subjects. Haemoglobin was estimated using cyanmethemoglobin method. **Results:** The overall prevalence of anaemia was 59%, 61%, 76% and 73% among pre-school children, adolescent girls, pregnant women and lactating mothers, respectively. Logistic regression analysis revealed that the risk of anaemia was two times higher among pregnant and lactating women and among the subjects belonged to scheduled caste and scheduled tribe communities. **Conclusion:** Anaemia is a severe public health problem among pre-school children and women of different physiological groups in rural Maharashtra. Therefore, there is a need to strengthen the existing national nutritional anaemia control programme and the community is encouraged to consume iron rich foods through health and nutrition education and information, education and communication (IEC) activities.

Key Words

Anaemia; Haemoglobin; Pre-School Children; Adolescent Girls; Pregnant Women Lactating Mothers.

Introduction

Anaemia is the most prevalent nutritional public health problem across the world affecting about half of pre-school age children and pregnant women in developing countries [1], while in India, it affects almost all ages and physiological groups, such as pre-school children, adolescent girls, pregnant women and lactating mothers, because of the increased demand for iron during pre-school life and adolescent age and additional demand during pregnancy and lactation [2]. About 60-70% of children below 6 years of age are suffering from various degrees of anaemia [3]. Iron deficiency is a major cause for anaemia among young children which impair their physical growth and cognitive functions, such as learning, memory and attention processes [4, 5]. Anaemia also affects immune status, physical capacity and work performance of adolescents and adults and increases morbidity. Adolescent girls are also most vulnerable as there is increased demand due to rapid growth spurt and menstrual blood loss. Since adolescent girls are the future mothers and if their dietary intakes are poor in iron, and if married before 18 yrs of age and become pregnant, they tends to become anaemic, adversely affecting the outcome of pregnancy.

The consequences of iron deficiency anaemia (IDA) during pregnancy includes increased risk of low birth weight or premature delivery, peri-natal and neonatal mortality, inadequate iron stores for the newborn, lowered physical activity, fatigue and increased risk of maternal morbidity [6]. Anaemia is also important cause of maternal deaths due to postpartum hemorrhage [7] and is directly

responsible for 20% maternal deaths and is an associated cause in another 20% of maternal deaths [1]. The World Health Organization [8] estimated that 56% of all pregnant women in developing countries are anemic, about 75% are from Southern Asia, and 88% from India. A pregnant woman with anaemia continues to be anaemic during lactation also. As reported by NFHS-3 [9] and NNMB [10], the prevalence of anaemia among lactating women in India was 63% and 78%, respectively.

Although several studies on prevalence of anemia have been carried out, a community based studies among different physiological groups, representing the entire State were not available for many States in India. Such State specific studies are useful for State governments, UN agencies and NGOs to initiate appropriate intervention measures, keeping in view the prevailing circumstances in the States.

Aims & Objectives

To assess the prevalence of anaemia among different physiological groups in the state of rural Maharashtra.

Material and Methods

Sampling design A community based cross-sectional study was carried out in rural areas of Maharashtra, India, adopting multi-stage stratified random **sampling procedure**. Present study was carried out by National Nutrition Monitoring Bureau (NNMB) during 2002-03. Sample size and sampling strategy. The sample size was calculated by considering the 70% prevalence of anaemia [1], with 95% confidence interval (CI), 80% power and 10% relative precision, a sample size of 336 was arrived for pre-school children, pregnant women and lactating mothers. However, a total of 404, 386 and 410 samples were covered for pre-school children, pregnant women and lactating mothers, respectively. In case of adolescent girls, the sample size was computed by assuming the prevalence of anaemia as 50% [11] with 95% confidence interval and 80% power. Thus, the sample size 784 was arrived at. However, a total of 833 adolescent girls were covered for the study.

Selection of villages: The villages covered by the National Sample Survey Organization (NSSO 1998) for its 54th round of consumer expenditure survey formed the sampling frame. The NSSO adopted a two-stage random sampling method. The village was the first stage-sampling unit (FSU), while the households (HHs) formed the second stage-sampling unit (SSU). The state was divided into different strata based on agro-climatic conditions, and one district or part of the district with a population of 1.8 million was considered as one stratum. For the purpose of the study, a total of 16 strata were selected randomly from the State and five villages were selected per stratum. Thus, a total of 80 villages were covered from 16 strata.

Selection of subjects The sample size to be covered for different physiological (target) groups in the village was determined on the basis of probability proportional to size (PPS) of the village. For this purpose, each selected village was divided into five geographical areas based on natural groups of houses or streets. Households belonging to Scheduled Caste and Scheduled Tribes community, who generally live as a group, constituted one of the five areas. All households in each geographical area were enumerated, and all the target subjects in each geographical area were allotted serial numbers. The required number of target groups to be covered in each village was determined based on the total number of target groups in that village and the total number of target groups in a given area. From each geographical area, the first household with target subjects (i.e. pre-school children, adolescent girls, pregnant women and lactating mothers) was selected randomly and contiguous households with target subjects were surveyed until the required number of subjects for each target groups was covered in each area. **Ethical clearance:** Ethical clearance was obtained from Institutional Ethical Review Committee, National Institute of Nutrition (NIN), Hyderabad and also from Scientific Advisory Committee of NIN. Written informed consent was obtained from the head of the household. **Data collection:** Data collection was carried out by trained Medical Officer, Nutritionist and Social Worker of NNMB, Maharashtra State unit using pre-tested questionnaire. Information was collected on household socio-demographic particulars. All the investigators were trained and standardized in pipetting finger-prick blood samples and estimation of haemoglobin by colorimeter. With the objective of achieving maximum intra- and inter-individual agreement, duplicate sample was collected in every 10th individual and the same were sent NIN for estimation of haemoglobin. To ensure the quality of data, scientific and technical staff from NIN made frequent supervisory visits to the field and re-examined the sub-sample of the data collected by the investigators. Knowledge and practice about anaemia and consumption of iron and folic acid (IFA) tablets was also collected from 251 mothers of pre-

school children using structured questionnaire.

Definition: "Household' is defines as those living together under one roof and sharing common kitchen. 'Pucca' house means walls made up of cement and bricks or stones and reinforced cement concrete roof (RCC), while 'semi pucca house' is one that has brick or stone wall and tiled or asbestos roof, 'kutcha' house had mud or thatched walls and thatched or tiled/asbestos roof.

Blood sample collection and standardization

A finger-prick blood sample of 20µL was collected using a fixed volume Finn pipette, and transferred it into a test tube containing 5mL of Drabkin's solution. The haemoglobin concentration was estimated by the cyanmethemoglobin method using a colorimeter (12). Diagnostic criteria

The criteria recommended by WHO (13) was used to diagnose anaemia among pre-school children, adolescent girls, pregnant women and lactating mothers. The cut-off value of <11 g/dL of haemoglobin was considered as anaemia for 1 to 5 year children and pregnant women, and <12 g/dL among adolescent girls and lactating women.

Statistical analysis: The data was analyzed using the Statistical Package for Social Sciences; Windows version 19. The mean haemoglobin values with standard deviation (±SD) were calculated according to age and gender and were compared by ANOVA F-test. The prevalence of anaemia by age and sex was analyzed using Chi-square ($\chi 2$) test. Multivariate logistic regression was done to study risk factors such as socio-demographic variables associated with risk of anaemia.

Independent variables such as community (other community), occupation of the head of the household, literacy of mother, age group, religion, family size and the sanitary latrine at the household level were included in regression analysis.

Results

Socio-economic and Demographic profile: More than half (58%) of the HHs belonged to Scheduled Caste / Scheduled Tribe communities, while 40% were Other Backward class. About half (51%) of HHs were living in semi-pucca houses, while 39% were living in kutcha houses. About 63% HHs were nuclear families, while 18% were joint families. About 30% fathers and 50% mothers of index children were illiterate. About 41% HHs did not possess agricultural land and 55% were engaged in either agricultural or non-agricultural labour. The majority (73%) of mothers were housewives and in 88% of HHs, the facility of sanitary latrine was absent.

Mean and standard deviation values for each age and physiological groups are presented in Table 1. In general, the mean hemoglobin values were low among pregnant women (9.7 g/dl (SD ±0.08) as compared to other physiological groups. While, the mean hemoglobin values were reported high among adolescent girls (11.4 g/dl (SD±0.08).

Prevalence of anaemia: The prevalence of anaemia among different physiological groups is presented in Table 2. The overall prevalence of anaemia among the pre-school children was 59% (CI=54.4-64.0). The prevalence was significantly ($p<0.01$) higher (90.9%) among 1-2 year children as compared to the children of other age groups and the prevalence was relatively higher ($p>0.05$) among girls (62.7%) as compared to boys (56.8%). While, the prevalence of anaemia was higher among pregnant women (75.9%: CI=71.6-80.2), followed by lactating mothers (72.9%: CI=68.6-77.2) and adolescent girls (61%: CI=54.4-64.0).

Anaemia vs. socio-demographic variables: Bivariate analysis revealed that the risk of anaemia was significantly higher among adolescent girls and pregnant women belonging to scheduled caste and scheduled tribe communities and among those engaged in labour and agriculture work (Table 3).

The logistic regression analysis between anaemia and different socio-demographic variables is presented in Table 4. The risk of anaemia was almost two times higher among pregnant (OR= 2.13; CI=1.56-2.92) and lactating women (OR= 1.93; CI=1.43-2.60) as compared to adolescent girls and among women belonging to Schedule Tribe and Schedule Caste communities (OR= 2.0; CI=1.47-2.73), as compared to their counterparts.

Discussion

This study, perhaps for the first time carried out by among different physiological groups covering state representing sample for the state of Maharashtra. The study revealed that the prevalence of anaemia is high among the rural pre-school children (59%), adolescent girls (61%), pregnant women (76%) and lactating mothers (73%) of Maharashtra suggesting that the anaemia is a severe public health problem (prevalence of anaemia ≥40%); [13]. While, the corresponding figures reported by NFHS 3, for the rural pre-school children, pregnant women and lactating mothers in Maharashtra were 63%, 58% and 53.5%, respectively [9].

Similarly, the present study revealed high prevalence of anaemia (61%) among rural adolescent girls in the state of Maharashtra. However, this prevalence is lower compared to other studies [11,14,15]. High prevalence of anaemia among adolescent girls may affect adversely on the outcome of their pregnancies, once they entered into marital life, because nutritional status of adolescent girls, particularly, iron status during pregnancy is inextricably linked to the birth weight of child and subsequently to child survival.

The higher prevalence of anaemia among pregnant and lactating women in the present study could be attributed to the differences in the methods adopted for the estimation of haemoglobin. In the present study, NNMB has adopted Cyanmethaemoglobin method, while NFHS-3 has adopted HemoCue method for the estimation of hemoglobin. It was established that, the HemoCue method over estimates hemoglobin levels as compared to Cyanmethaemoglobin method [12]. High prevalence of anaemia among pregnant women is great concern for India as it is one of the leading causes of maternal death and increase in perinatal mortality [16]. However the current prevalence among pregnant and lactating women was lower compared to other studies [17-20].

High prevalence of anaemia among different physiological groups in India as well as in Maharashtra is attributed to poor consumption of iron rich foods as majority of population in rural areas were subsisting on inadequate and predominantly vegetarian diets. This was correlated by the survey carried out in the state of Maharashtra and other NNMB states during 2002 [21]. In rural Maharashtra, the mean household intakes of green leafy vegetables, the important source of iron, was grossly deficit by 78% and the inadequacy (<70% RDA) of median intakes of iron was 55%. Similarly, the individual intakes of green leafy vegetables was also grossly deficit in all physiological groups ranging from 82% in adolescent girls to 92% in pre-school children. About 61-88% of subjects were consuming inadequate (<70% of RDA) amounts of iron [21]. The predominant source of iron for the rural population was vegetarian diet i.e. the intake of iron is in the form of non-haem iron. The bio-availability of non-haeme iron is poor as the vegetarian diet consisting of phytates, oxalates, carbonates, phosphates and dietary fibre, which interfere with iron absorption.

Coverage of iron and folic acid (IFA) tablets among different physiological groups revealed that only about 12% pre-school children and 29% lactating mothers reportedly received IFA tablets, and none of them consumed the stipulated ≥90 IFA tablets. However, about 71% of pregnant women received ≥90 IFA tablets, while only 50% of them consumed the stipulated ≥90 IFA tablets; which was similar to the findings reported by the other study [22]. Majority of the population in rural Maharashtra were practicing open defecation, as the majority of HHs do not have sanitary latrine facility and they are at risk of hookworm infestation, the most common cause of iron deficiency anaemia [23]. The negative association between the prevalence of anaemia and absence of sanitary latrine in the present study could be attributed to very low proportion of households' possessed sanitary latrines and majority of the sanitary latrines were not in use.

Conclusions and Recommendations

It is concluded that anaemia is a severe public health problem among pre-school children and women of different physiological groups in rural Maharashtra. Therefore, the existing National Nutritional Anaemia Control Programme [24] should be strengthened by improving the coverage and compliance of iron and folic acid tablets consumption among beneficiaries. The community is also needs to be encouraged to consume iron rich foods through health and nutrition education and information, education and communication (IEC) activities. It is also recommended that the staple food should be fortified with micronutrients including iron to control and prevention of anaemia in the vulnerable groups of population [25]. It is also recommended periodic de-worming among pre-school children.

Limitation of the study

The study was carried out in rural areas of Maharashtra during the period 2002-2003 and the final report was published in 2005. The data presented in this manuscript is still the latest in the state. Information on household and individual dietary history was not obtained in the present study; hence we reported the dietary information collected by NNMB during 2002.

Relevance of the study

Anemia is still a severe public health problem in India, particularly among rural vulnerable population such as pre-school children, adolescent girls, pregnant and lactating women. This study also revealed high prevalence of anemia among the rural population of Maharashtra. The study will help in planning appropriate intervention

strategies for the state Government for prevention and control of anemia.

Authors Contribution

All the authors contributed in conception, design, analysis and interpretation of data. AN and IIM drafted the article and NBK analyzed the data. All the authors critically reviewed and approved final version of the manuscript.

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Tables

TABLE 1 MEAN (SD±) VALUES OF HAEMOGLOBIN BY DIFFERENT PHYSIOLOGICAL GROUPS

Physiological group	n	Mean (g/dL)	SD
Children			
1-5 yr children	404	10.4	±0.08
12-17+yr girls	833	11.4	±0.08
Pregnant women	386	9.7	±0.08
Lactating mothers	410	10.8	±0.08

†SD-standard deviation

TABLE 2 DISTRIBUTION (%) OF GRADES OF ANAEMIA AMONG DIFFERENT PHYSIOLOGICAL GROUPS

Preschool children		Grades of Anaemia						
Age group (Yrs)	n	Normal	Mild	Mod	Severe	Pooled	95% CI [a]	P- value
1+	22	9.1	18.2	68.2	4.5	90.9	78.9-102.9	<0.001
2+	76	27.6	14.5	53.9	3.9	72.4	62.3-82.5	
3+	119	37.8	22.7	36.1	3.4	62.2	53.5-70.9	
4+	187	51.9	21.9	24.1	2.1	48.1	40.9-55.3	
Pooled	404	40.8	20.5	35.6	3.0	59.2	54.4-64.0	
Gender								
Boys	243	43.2	21.8	32.1	2.9	56.8	50.6-63.0	>0.05
Girls	161	37.3	18.6	41.0	3.1	62.7	55.2-70.2	
Adolescent girls								
12-14 yrs	415	42.2	39.5	17.8	0.5	57.8	53.0-62.6	<0.06
15-17 yrs	418	35.9	43.2	19.9	1.0	64.1	59.5-68.7	
Pooled	833	38.9	41.4	18.9	0.8	61.1	57.8-64.4	
Women								
Pregnant	386	24.1	22.0	49.8	4.1	75.9	71.6-80.2	<0.05
Lactating	410	27.1	44.6	25.9	2.4	72.9	68.6-77.2	

a. Confidence Interval

TABLE 3 RISK OF ANAEMIA AMONG DIFFERENT PHYSIOLOGICAL GROUPS ACCORDING TO SOCIO-DEMOGRAPHIC VARIABLES-BIVARIATE ANALYSIS

Socio-demographic variables	Anaemia (OR , CI)*			
	Preschool children	Adolescent girls	Preg. women	Lactating mothers
Community				
Others	1.0	1.0	1.0	1.0
SC+ST#	1.18 (0.67-2.10)	2.06 (1.38-3.06)	3.69 (1.88-7.25)	1.72 (0.94-3.14)
OBC@	0.88 (0.53-1.51)	1.27 (0.89-1.83)	2.26 (1.27-4.01)	0.97 (0.56-1.64)
Religion				
Others	1.0	1.0	1.0	1.0
Hindu	0.76 (0.32-1.55)	1.14 (0.73-1.85)	0.95 (0.44-2.14)	0.55 (0.24-1.22)
Family Size				
1-4	1.0	1.0	1.0	1.0
>=5	0.72 (0.46-1.11)	0.86 (0.61-1.23)	0.68 (0.42-1.09)	0.95 (0.59-1.53)
Occupation of head of HH				
Service+ Business	1.0	1.0	1.0	1.0
Labours	0.98 (0.57-1.67)	1.48 (1.02-2.18)	1.61 (0.92-2.82)	1.21 (0.65-2.23)
Agriculture	0.83 (0.47-1.48)	0.85 (0.58-1.24)	1.87 (1.01-3.46)	0.60 (0.32-1.10)
Adult female literacy				
Literate	1.0	1.0	1.0	1.0
Illiterate	0.92 (0.61-1.37)	1.30 (0.98-1.72)	1.17 (0.71-1.92)	1.54 (0.96-2.46)
Sanitary latrines				
Present	1.0	1.0	1.0	1.0
Absent	0.79 (0.42-1.46)	0.79 (0.51-1.22)	0.97 (0.49-1.90)	0.97 (0.53-1.77)

#SC-scheduled caste, ST-scheduled tribe, @OBC- Other Backward Caste, *OR-Odds Ratio, CI- Confidence Intervals

TABLE 4 MULTIPLE LOGISTIC REGRESSION ANALYSIS FOR RISK OF ANAEMIA

Variable	OR*	95% CI β	p-value
Physiological groups			
Adolescent girls	1.0	-	
Pregnant women	1.98	1.48-2.65	0.00
Lactating mothers	1.78	1.36-2.33	0.00
Community			
Others [a]	1.0	-	
SC+ST	2.23	1.56-3.18	0.00
OBC	1.50	1.10-2.03	0.00
Religion			
Others [†]	1.0	-	
Hindu	0.69	0.45-1.05	0.08
Occupation of head of HH			
Service+ Business	1.0	-	
Labours	1.23	0.90-1.68	NS
Agriculturists	1.0	0.74-1.34	NS
Family size			
1 - 4	1.0	-	
≥ 5	0.85	0.66-1.08	NS
Literacy status			
Literate	1.0	-	
Illiterate	1.22	0.98-1.54	0.07
Sanitary latrine			
Present	1.0	-	
Absent	0.69	0.49-0.97	0.03

SC-scheduled caste, ST-scheduled tribe, OBC- Other Backward Caste, *OR- odds ratio, β CI-Confidence Interval: a others =Forward caste, †Others: Christians, Muslims and Buddhists